

Rapid Implementation of a Statewide Observational Surveillance System to Monitor Wearing of Face Masks in Public Spaces

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Abstract

This report describes the rapid implementation of a statewide observational surveillance program to monitor the public's wearing of face masks in public spaces during community spread of Coronavirus disease 2019 (COVID-19). It describes how the Hawai'i State Department of Health partnered with University of Hawai'i faculty to develop and implement the surveillance program. The surveillance program involved organizing volunteers to conduct weekly direct observations in designated locations. A smartphone application (app) was created to record real-time observational surveillance data. From September 5, 2020, to March 13, 2021, a total of 84 577 observations were conducted across the state. Eighty-three percent of those observed were correctly wearing a face mask, 7% were wearing a face mask incorrectly, and 10% were not wearing a mask. Following the 2-week pilot phase of the project, volunteers were surveyed regarding facilitators and barriers for conducting observations and motivations for volunteering. Feedback was used to refine project procedures. With few states having implemented such a surveillance program, the information reported in this article may inform communities interested in tracking mask-wearing behaviors in the context of the COVID-19 pandemic.

Keywords

COVID-19, SARS-CoV-2, Face Mask, Hawaii, Public Health Surveillance, Smartphone

Abbreviations and Acronyms

CDC = Centers for Disease Control and Prevention
COVID-19 = Coronavirus disease 2019
DOH = Department of Health
RSL = Resolve to Save Lives
UH = University of Hawai'i

Introduction

The Coronavirus disease 2019 (COVID-19) pandemic has severely impacted the State of Hawai'i, resulting in hundreds of lives lost, thousands infected, and major disruption to the livelihoods of Hawai'i residents. Although the number of daily cases statewide has decreased since hitting a peak of 353 cases per day in August 2020, the persistent threat of a "third wave" remains a major concern for the state. With COVID-19 vaccines in short supply, public health interventions have continued to rely upon strategies to limit transmission of the virus. Wearing a face mask is 1 of 3 key actions, along with handwashing and maintaining physical distancing, that people can take to prevent the spread of COVID-19.¹ To reduce the risk of COVID-19

transmission, the Centers for Disease Control and Prevention (CDC) recommends that all people over the age of 2 years wear masks in public places when around people outside of their household, especially in settings where social distancing cannot be maintained.²

Real-time data are an essential tool for informing decision-making for infectious disease control. Metrics to assess adherence to public health measures are useful to inform the response to COVID-19. "Observed mask-wearing" has been identified by Resolve to Save Lives (RSL) as 1 of 15 essential indicators for effective COVID-19 response. RSL recommends that all states report the percentage of people wearing masks correctly in public settings (eg, mass transit, shopping) using a standard, consistent method by week. Few states in the United States routinely report this metric.³ As Hawai'i State Department of Health (DOH) state emergency managers and elected officials sought to develop metrics for use by decision-makers, this RSL metric was identified as essential for assessing ongoing community prevention activities. This article describes how a statewide observational surveillance system was developed to monitor the public's wearing of face masks in public spaces. The program was rapidly implemented to track face mask usage patterns by the general public. Although the State of Hawai'i mandates the use of face masks in public areas,⁴ little was known regarding mask-wearing behaviors in Hawai'i before the launch of this project.⁵

Methods

Faculty at the University of Hawai'i (UH), under the guidance of the Hawai'i State DOH, worked collaboratively to design and rapidly implement a statewide observational surveillance system to monitor the wearing of face masks in public spaces. Methodology for observation sampling was guided by RSL recommendations.⁶ The program was piloted on two days: September 5, 2020, and September 12, 2020. The pilot involved 79 volunteers conducting observations in all 4 Hawai'i state counties. Adjustments were made based on the volunteers' feedback after the pilot.

Once per week, teams of 2 volunteers observed people in designated areas and recorded face mask usage. Observations were recorded at the same time and day each week. Each volunteer

observed people for 2 hours or until 100 observations were recorded. Observations were recorded as: “Wearing Correctly,” “Wearing Incorrectly,” or “No Mask.” “Wearing Correctly” was defined as wearing a face mask that completely covered the wearer’s nose and mouth.² “Wearing Incorrectly” was defined as wearing a face mask in any other way, such as having the wearer’s nose exposed, wearing the mask around the neck, or hanging from 1 ear. Volunteer pairs were instructed to initially observe the same people together to establish inter-rater reliability before recording observations. Once inter-rater reliability was established, volunteers were instructed to observe different people to avoid duplication of observations. For example, volunteers were instructed to conduct observations on opposite sides of the street or walkways from their partner or position themselves to observe different areas from their partner. Per CDC recommendations regarding mask-wearing in public spaces, volunteers observed individuals who appeared aged 2 years or older. Designated areas for observations were outdoor commercial zones selected with input from county health officials and members of the project team. Observation sites were spread out on each island to include multiple regions of each county each week. Sites were revisited weekly or every other week. Observations were limited to outdoor spaces because of the scarcity of public indoor spaces on all islands. Commercial zones were selected over areas like parks and beaches to minimize the effect of people engaged in activities, such as exercise, for which they would not be expected to wear a mask. Commercial zones, in general, involve people going into and out of indoor retail facilities, and therefore mask-wearing behavior is of more significance from a disease control perspective. Data was recorded using a smartphone application (app) or paper form. Data collected were aggregated by county and reported weekly as a community prevention metric for the DOH COVID-19 data dashboard.⁷

Smartphone App

The smartphone app was developed by UH engineering staff to facilitate the recording of observations. Desired qualities driving the development of the app were that it (1) be simple to use with minimal training, (2) be able to be used discreetly by observers, and (3) generate real-time data that could be sorted by zip code for seamless integration into the DOH COVID-19 data dashboard. A beta version was tested by project coordinators and refined with input regarding usability and functionality. A “web app” format avoided the need for downloading the app onto a cell phone before use. It also allowed developers to make rapid updates.

Unique features of the app facilitate rapid data collection and reporting. Data collected by volunteers were uploaded instantaneously to the app’s website. Upon starting the app, users were prompted to input their name, zip code, and location code to ensure all data generated include the name of the data collector and location where each observation was made. Observations

were tallied and displayed in real-time so that volunteers could note the total number of observations as well as the number in each category of “Wearing Correctly,” “Wearing Incorrectly,” or “No Mask” during their shift. A clicking noise sounded each time an observation was recorded to assure volunteers their data were noted. Finally, when volunteers recorded 100 observations, a notification displayed stating that the quota had been reached. Volunteers unable to use the app on a cell phone could manually input tallies into the app’s website using a computer.

Volunteer Training

Each volunteer was required to complete a 15-minute live or recorded virtual training session. The training session discussed the project’s purpose, instructions on conducting and recording observations, and safety precautions. The DOH provided volunteers with a letter to show authorities if questioned while conducting observations. Following the first 2-week pilot run of the project, volunteers were sent an 8-question survey regarding their role as a volunteer. Five items assessed the clarity of instructions provided, the sufficiency of knowledge that volunteers had to serve as data collectors, perception of safety while conducting observations, ease of use of the observation application, and perceived confidence in the ability to accurately collect data. These survey items used a 5-point Likert scale, with 1 being “Strongly Disagree” and 5 being “Strongly Agree.” Two open-ended questions asked volunteers about facilitators and barriers encountered while collecting data in the field. Finally, volunteers were also asked about their motivations for volunteering.

Results

Between September 5, 2020, and March 13, 2021, a total of 202 volunteers affiliated with the UH, the Hawai‘i State Medical Reserve Corps, and other community groups participated in the project. Volunteers recorded 84 577 observations at 58 sites on 5 Hawaiian islands. Observation data showed that statewide during this period, 83% of people wore masks correctly, 7% wore masks incorrectly, and 10% wore no mask (Table 1). Figure 1 illustrates trends regarding persons observed correctly wearing a mask by county by week. Although variation can be seen each week across the 4 counties, the overall percentage of the population observed wearing a mask correctly across the state increased since the beginning of the observation period. Kaua‘i County exhibited lower mask-wearing percentages than other counties.

Table 1. Face-Mask Usage Observations Collected in Hawai‘i, September 5, 2020–March 13, 2021 (N=84 577)

| Observations | n | % |
|--------------------------|--------|----|
| Wearing mask correctly | 70 376 | 83 |
| Wearing mask incorrectly | 5554 | 7 |
| No mask | 8647 | 10 |

Of the 79 volunteers that participated in the pilot, 41 (51.9%) responded to the survey. Feedback was overwhelmingly positive regarding clarity of instruction (mean, 4.6), sufficiency of knowledge to serve as a data collector (4.7), perception of safety (4.8), ease of use of the app (4.5), and confidence in ability to collect accurate data (4.6). Responses are summarized in Table 2.

Volunteers provided various motivations for volunteering, including receiving college credit (n=16; 39%), wanting to serve the community (n=13; 22%), self-gratification for volunteering (n=5; 12%), and other reasons (n=7; 17%). Responses are summarized in Table 3. Qualitative comments provided insight into volunteers' experiences recording observations. Some comments focused on the app's functionality (eg, occasionally froze or lagged). One participant remarked how despite being skeptical of using an app, observation collection went very smoothly. Other comments pertained to methodology. Volunteers commented that they needed greater clarity regarding who to observe and at what point to record their observations. For example, volunteers noted that persons walking to and from the ocean and those stepping in and out of cars were not wearing masks at the time of observation but donned masks after being observed. Volunteers requested greater guidance regarding how to avoid counting the same individuals as their partners. Feedback regarding the designated locations was also provided. Some sites were sparsely populated at the time of observation. Volunteers suggested changing the locations or the time of day that observations were conducted to be in areas with more foot traffic. Volunteers noted that because many of the sites were located in commercial shopping areas, mask-wearing behaviors may differ in other types of settings, such as parks and beaches.

Table 2. Facilitators and Barriers Reported By Volunteers Piloting Mask Observation Study in Hawai'i, September 2020 (N=41)

| Question ^a | Mean (SD) | Median |
|---|-----------|--------|
| The instructions provided were clear. | 4.6 (0.6) | 5 |
| I have sufficient knowledge to serve in the role of data collector. | 4.7 (0.5) | 5 |
| I felt safe while in the field collecting data. | 4.8 (0.5) | 5 |
| The face mask observation application was easy to use. | 4.5 (0.8) | 5 |
| I am confident that I will be able to collect data in an accurate manner. | 4.6 (0.7) | 5 |

Abbreviation: SD, standard deviation.

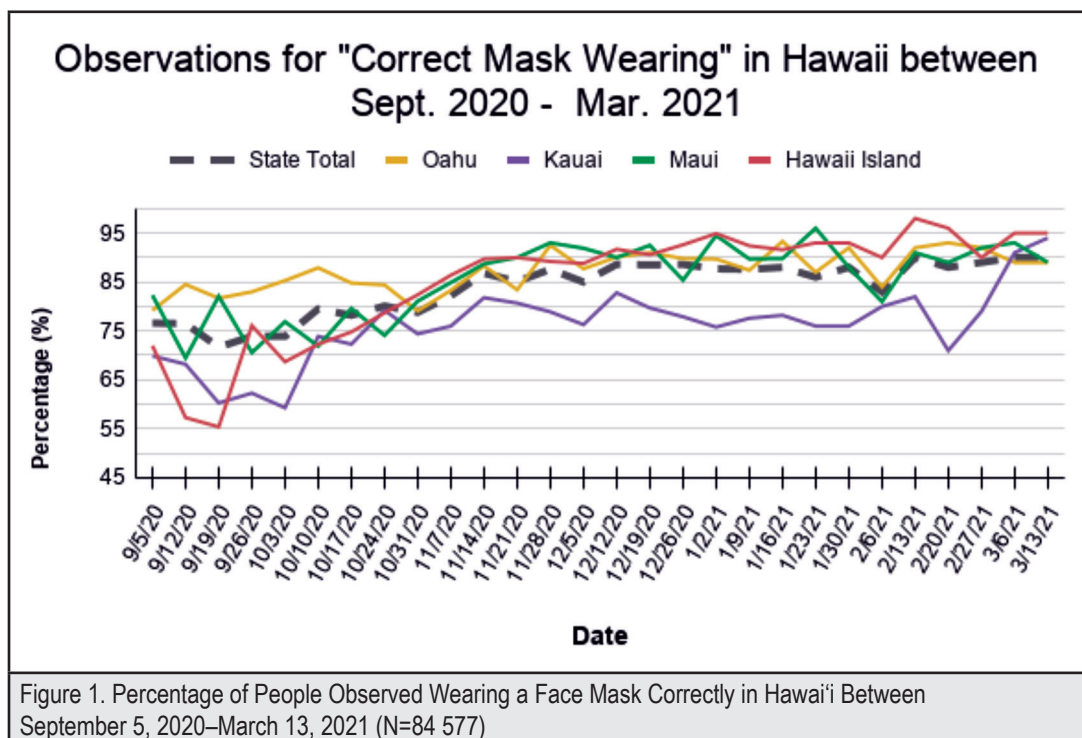
^a Survey items used a 5-point Likert scale, with 1 being "Strongly Disagree" and 5 being "Strongly Agree."

Table 3. Volunteer Motivations for Participating in Pilot Face Mask Observation Study in Hawai'i, September 2020 (N=41)

| Volunteer motivations for participating in the study | n (%) |
|--|-----------|
| College course credit | 16 (39.0) |
| Want to serve my community | 13 (31.7) |
| Self-gratification for volunteering | 5 (12.2) |
| Other ^a : Interest in the success of COVID-19 public health measures Learn more about collecting public health data It looks good on a resume Interested in public health & public health nursing | 7 (17.1) |

Abbreviation: COVID-19, Coronavirus disease 2019.

^a "Other" motivations represent write-in responses



Discussion

Mitigating the spread of infections is critical to protecting public health and decreasing the strain on healthcare resources. Widespread use of masks in community settings can prevent the transmission of respiratory diseases caused by coronaviruses and other respiratory viruses.⁸ By developing an observational surveillance program to track face mask-wearing, patterns of usage can be more readily identified. The methodology described in this report can be used to assess mask-wearing behavior in relation to local mandates and other changing conditions in a community. Changes in mask usage can be assessed regarding the resumption of in-person learning at schools, increases in tourism, social or holiday season activities, and changes in disease activity. Such information can inform public health education efforts and lead to more targeted messaging and outreach to populations at risk for COVID-19. For example, on October 15, 2020, the State of Hawai'i initiated its pre-travel testing program, allowing all airline passengers arriving from out of state to be exempt from the 14-day mandatory quarantine with a negative test result within 72 hours of departure. This policy resulted in a higher number of visitors to the state. Having the observational surveillance program in place before this policy change allowed emergency planners the ability to assess mask-wearing behavior as tourism activity rose in each county. Similarly, following an emergency proclamation by the governor on November 16, 2020, that established a single statewide mask mandate for the islands,⁴ the impact on mask-wearing behaviors in public areas following this critical policy change could be tracked.

Following the program pilot, various adjustments were made. Volunteer feedback was incorporated into the program's protocols. Improvements were made to the app to enhance the user experience and streamline data reporting. Volunteers were provided clarifying instructions on who to include in their observations and when to record their observations. For example, volunteers were instructed to exclude persons actively eating, drinking, smoking, or exercising. Such instructions aligned with mask-wearing guidelines provided by state and county governments.⁷ Observation site selection was refined to provide greater standardization of the data collected. The pilot phase of the project included a mixture of commercial areas and recreational areas (eg, parks, beaches). After the pilot stage of the project, the focus shifted to commercial areas. Furthermore, 1 airport was included as an observation site due to the importance of tourism in the local economy.

Global studies provide evidence for an association between community mask mandates and improved COVID-19 outcomes.⁹ To date, little is known regarding adherence to state mandates regarding the use of face masks in public spaces in the United States. Similarly, little is known about the extent to which mask-wearing is becoming a social norm in the context of the COVID-19 pandemic. An observational study conducted

in Wisconsin found that approximately 41% of shoppers wore a mask when entering retail stores in June 2020; mask-wearing behavior increased to over 90% in July and August following the enactment of mask mandates in the state.¹⁰ A statewide survey conducted in August 2020 asked Hawai'i residents about self-reported mask-wearing behavior. The survey found that 84% reported wearing face masks all or most of the time while outside in a public space.¹¹ A separate survey conducted in October 2020 asked Hawai'i residents how often they wear a mask outside the home, to which 90% reported "multiple times in the past month."¹² An observational study of face mask usage in outdoor public spaces in Honolulu, Hawai'i found that of the 200 individuals observed, 77% used face masks correctly; in contrast, 23% were incorrectly masked or not masked.⁴ Observation data collected by this project during September 5, 2020, and March 13, 2021, showed that 83% of people wore masks correctly, 7% wore masks incorrectly, and 10% wore no mask while out in public spaces. While there is an overall positive trend in mask-wearing across the state, Kaua'i County exhibited lower percentages of correct mask-wearing than other counties. Kaua'i County had consistently had lower disease rates than the other counties, potentially contributing to a lower level of concern about disease transmission. RSL recommends that the target metric for people wearing masks correctly in public areas be at least 80% or greater.³ In Hawai'i, there is still room for improvement.

A strength of the project has been that it provided citizens with the opportunity to engage in and contribute to the COVID-19 public health response in their communities. Volunteers described being motivated by a desire to serve their community, a sense of self-gratification for volunteering, and a willingness to learn about public health. Establishing a role for general citizens to contribute to the public health response to a crisis can promote social connectedness and may ultimately contribute to community resilience.¹³ Understanding volunteer motivation for participating helped inform the project team's volunteer recruitment and retention efforts.

The study has multiple limitations. Mask-wearing behaviors recorded by the study may not be representative of the overall population. Behaviors may differ if observations were recorded at different times or locations. Observers did not have knowledge of persons who could not wear masks for personal health or other reasons. It is important to note that the goal of the study was to assess changes in behavior and social norms in regards to mask-wearing in Hawai'i rather than to assess compliance with regulations. Observations were independent of mask-wearing rules, as the observation is of behavior, not of compliance. Independent of local rules, national guidance recommend that mask-wearing is protective and should be done in a wide variety of settings.

Mask-wearing behaviors are influenced by how often people observe others wearing them.¹⁴ Regular reporting of mask-wearing

behaviors may serve as a means for encouraging the uptake of healthy behaviors in the community through public messaging. Mask-wearing is an indicator for which individuals can take action to make a difference. Other indicators for COVID-19 response, such as ongoing dashboard reporting of case rates or lab positivity rates, or hospital bed availability, are of great interest to the public health response but are not necessarily empowering for the general public. Ongoing dashboard mask-wearing data, in contrast, is something each individual has the power to change through their daily behavior. Implementation of a sound mask-wearing behavior monitoring system provides essential information to the DOH and the public.

Conflict of Interest

None of the authors identify a conflict of interest.

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References

1. Centers for Disease Control and Prevention. Coronavirus Disease 2019 (COVID-19). Coronavirus Disease: Protect Yourself. Available from: <https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/prevention.html>. Published October 28, 2020. Accessed November 2, 2020.
2. Centers for Disease Control and Prevention. Coronavirus Disease 2019 (COVID-19). Coronavirus Disease: Considerations for Wearing Masks. Available from: <https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/how-to-wear-cloth-face-coverings.html>. Published August 7, 2020. Accessed September 16, 2020.
3. Resolve to Save Lives. Tracking COVID-19 in the United States. Available from: <https://preventepidemics.org/wp-content/uploads/2020/07/Tracking-COVID-19-in-the-United-States-Report.pdf>. Published July 21, 2020. Accessed September 12, 2020.
4. Officer of the Governor State of Hawaii. Fifteenth Proclamation Related to the COVID-19 emergency. Available from: https://governor.hawaii.gov/wp-content/uploads/2020/11/2011051-ATG_Fifteenth-Proclamation-Related-to-the-COVID-19-Emergency-distribution-signed.pdf. Published November 16, 2020. Accessed January 12, 2021.
5. Tamamoto KA, Rousslang ND, Ahn HJ, Better HE, Hong RA. Public Compliance with face mask use in Honolulu and regional variation. *Hawaii J Health Soc Welf*. 2020;79(9):268–271.
6. Resolve to Save Lives. Promoting Mask-Wearing During the COVID-19 Pandemic: A Policymaker's Guide, Annex II: Mask-Use Adherence Measurement Technical Reference. Available from: <https://preventepidemics.org/wp-content/uploads/2020/08/Annex-II-technical-reference-for-monitoring.pdf#:~:text=Annex%20II%3A%20Mask-Use%20Adherence%20Measurement%20Technical%20Reference.%20This,that%20can%20be%20used%20to%20inform%20decision%20making>. Published August 27, 2020. Accessed September 12, 2020.
7. Hawaii State Department of Health. (n.d.) What You Should Know: Get The Facts About COVID-19. Available from: <https://health.hawaii.gov/coronavirusdisease2019/what-you-should-know/current-situation-in-hawaii/>. Accessed January 19, 2021.
8. MacIntyre CR, Chughtai, AA. A rapid systematic review of the efficacy of face masks and respirators against coronaviruses and other respiratory transmissible viruses for the community, healthcare workers and sick patients. *Int J Nurs Stud*. 2020; 108:103629. <https://doi.org/10.1016/j.ijnurstu.2020.103629>
9. Leffler CT, Ing E, Lykins JD, Hogan MC, McKeown CA, Grzybowski A. Association of country-wide Coronavirus mortality with demographics, testing, lockdowns, and public wearing of masks. *Am J Trop Med Hyg*. 2020;103(6):2400–2411. doi: 10.4269/ajtmh.20-1015
10. Haischer MH, Beifuss R, Hart MR, et al. Who is wearing a mask? Gender-, age-, and location-related differences during the COVID-19 pandemic. *PLOS One*. 15(10):e0240785. <https://doi.org/10.1371/journal.pone.0240785>
11. Moore C, Hayashi S, Lanfranchi R. Hawai'i during COVID-10: A Community Impact Survey. Available from: https://drive.google.com/file/d/1F2gfRKwbUvkbw_cfCewS6JUEnmIQDNG/view. Published September 21, 2020. Accessed October 30, 2020.
12. SMS Research & Marketing Service Inc. Community Pulse Survey. Available from: <https://www.smshawaii.com/studies/community-pulse-survey>. Accessed January 19, 2021.
13. National Biodefense Science Board. Community Health Resilience Report. Available from: <https://www.phe.gov/Preparedness/legal/boards/nbsb/meetings/Documents/nbsb-chrreport.pdf>. Published April 23, 2013. Accessed January 13, 2021.
14. Barile JP, Guerin RJ, Fisher KA, et al. Theory-based behavioral predictors of self-reported use of face coverings in public settings during the COVID-19 Pandemic in the United States. *Ann Behav Med*. 2021;55(1):82–88. doi:10.093/abm/kaa109